Comparison of Indoor/Outdoor/Personal EC and OC Levels in Tianjin, China

Can Niu, Zhipeng Bai, Fei He

College of Environmental Science and Engineering,
Nankai University, 300071 Tianjin, China
May 12, 2010, Xi'an
1. Introduction
2. Panel study
3. Results
4. Conclusion
5. Research directions in the future
6. Acknowledgements
1. Introduction:
Pre-study of Air Quality Criteria for PM

Outdoor/Indoor/Personal monitoring
Time-activity pattern

Ambient air PM Characteristics

Exposure assessment to PM for human

Microenvironment-time weighted model

Health effect studies (chronic/acute)

PM-health injury/damage mechanism

Emission sources
Transmission mechanism
Source apportionment

The relationship between I/O

Deposition mechanism

Nankai University
2. Panel Study:
Exposure to PM$_{10}$ for the elderly in Tianjin

The proportion of the elderly population (%) in the world, China and Tianjin

<table>
<thead>
<tr>
<th>Year</th>
<th>The world</th>
<th>China</th>
<th>Tianjin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>6.6</td>
<td>6.1</td>
<td>8.15</td>
</tr>
<tr>
<td>2008</td>
<td>7.7</td>
<td>8.3</td>
<td>11.88</td>
</tr>
<tr>
<td>2020</td>
<td>9.3</td>
<td>11.5</td>
<td>15.68</td>
</tr>
<tr>
<td>2050</td>
<td>14</td>
<td>23.97</td>
<td>24.93</td>
</tr>
</tbody>
</table>

http://baike.baidu.com/view/725231.htm
Experimental Method:

- Outdoor, indoor and personal PM$_{10}$ samples of a panel-study (80 old people aged 55-75) were collected on pre-baked Teflon and quartz filters in summer and winter 2009 during the Program of Pre-study of Air Quality Criteria for PM in Tianjin, China.

- Research community: Kunchengyuan, Dongli District, Tianjin
Experiment contents:

Outdoor sampling

Indoor sampling

Personal sampling

Filling in questionnaire

Nankai University
Experiment instruments:

- Community sampling
- Flow calibrating
- Sampling pump

Nankai University
Analysis methods:

- The mass concentrations were measured under constant temperature (21±2°C) and humidity conditions.
- Organic carbon (OC) and elemental carbon (EC) were analyzed by the thermal optical reflectance method following the IMPROVE-A protocol.

Following the IMPROVE-A protocol, personal exposure was assessed. So relationship analysis between personal PM$_{10}$ and carbonaceous materials was carried out to determine the real level of total exposure.
3. Results:

3.1 Mass concentration of PM$_{10}$ in summer and winter

![Box plot showing mass concentration of PM$_{10}$ in summer and winter for personal, indoor, and outdoor environments.](image)
3.2 Carbonaceous species concentration analysis

**Concentration, mg/m³**

**Summer**

**Winter**

- **Personal**
- **Outdoor**
- **Indoor**
### 3.3 The ratio of Carbonaceous species and PM$_{10}$ concentration

<table>
<thead>
<tr>
<th>Concentration ratio</th>
<th>TC/PM$_{10}$</th>
<th>OC/PM$_{10}$</th>
<th>EC/PM$_{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor</td>
<td>15.50%</td>
<td>11.99%</td>
<td>3.51%</td>
</tr>
<tr>
<td>Indoor</td>
<td><strong>26.33%</strong></td>
<td><strong>21.30%</strong></td>
<td><strong>5.01%</strong></td>
</tr>
<tr>
<td>Person</td>
<td>21.70%</td>
<td>19.35%</td>
<td>2.88%</td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor</td>
<td>32.5%</td>
<td>24.9%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Indoor</td>
<td>30.5%</td>
<td>25.2%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Person</td>
<td><strong>35.7%</strong></td>
<td><strong>30.4%</strong></td>
<td><strong>5.4%</strong></td>
</tr>
</tbody>
</table>
### 3.4 The correlation of indoor, outdoor and personal carbon components

<table>
<thead>
<tr>
<th>Correlation of concentration</th>
<th>Personal-Indoor</th>
<th>Personal-Outdoor</th>
<th>Indoor-Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>0.48</td>
<td>0.17</td>
<td>0.40</td>
</tr>
<tr>
<td>OC</td>
<td>0.56</td>
<td>0.23</td>
<td>0.35</td>
</tr>
<tr>
<td>EC</td>
<td>0.57</td>
<td>0.49</td>
<td>0.51</td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>0.89</td>
<td>0.78</td>
<td>0.81</td>
</tr>
<tr>
<td>OC</td>
<td>0.91</td>
<td>0.73</td>
<td>0.74</td>
</tr>
<tr>
<td>EC</td>
<td>0.77</td>
<td>0.81</td>
<td>0.86</td>
</tr>
</tbody>
</table>
4. Conclusion

- PM$_{10}$ pollution in winter was heavier because of heating and insufficient ventilation.
- Personal exposure to PM$_{10}$ was greater and more complicated which suggesting the existence of exposure error in the environmental epidemiological study by using the regional concentration instead of real personal exposure.
- OC made up the majority of TC and accounted for 12–30% of mass concentration of PM$_{10}$. The correlation coefficient between indoor and personal OC was higher than others, 0.56 in summer, 0.91 in winter because of the old people spending more than 80% time indoors.
5. Research directions in the future

- Relationship between air pollution and the elderly common and frequently-occurring disease (respiratory, cardiovascular, cancer, high blood pressure, etc.)
- Health risks of PM containing hazardous and toxic substances to sensitive population
- Health damage mechanism of PM for sensitive population
- Combined effects derived multiple pollutants on health
- Set up different age groups to carry out long-term exposure monitoring and analysis for an updating database
6. Acknowledgements

As with any endeavor, this research project could not have been completed without the help and support of others. Foremost, I wish to thank my research advisor Prof. Zhipeng Bai. Your guidance throughout the course of this project is greatly appreciated. I would also like to thank you for reviewing this thesis. I am indebted to many members of my research group: Yan You, Jian Zhou, Jiefeng Zhang, Yating Liu, Nan Zhang, Fei He, and Lu Wang. I really appreciate the participants and the elderly in the community for their support.
Welcome to Tianjin!

Tianjin Binhai new area

Nankai University
Nankai University

Thank You!

selina@ www.p960.com